A 56-year-old male was referred for treatment of an ulcer to the left plantar 3rd metatarsal head. The patient was a non-smoker and had a 20-year history of Type 2 diabetes mellitus with good control (HbA1c 54 mmol/mol), low-level heart failure, chronic kidney disease and considerable diabetic retinopathy. The patient’s regular treatment included Novomix 30, Furosemide, Lercanidipine, Lisinopril, Atorvastatin, Brinzolamide and Timolol eyedrops. He had palpable, monophasic pulses and peripheral neuropathy (absent response to a 10g monofilament). He had previously had angioplasty to both legs.

CLINICAL HISTORY

The patient presented with a three-year history of recurrent ulceration to the plantar aspect of the left foot at the level of the 3rd metatarsal shaft (Figure 1). He had undergone progressive amputations on the left foot due to ulceration and infection, culminating in a transmetatarsal amputation three years previously. Remodelling of the metatarsal stumps was evident on X-ray (Figure 2) and was thought to be increasing pressure on the plantar soft tissues, resulting in chronic ulceration. There was no evidence of osteomyelitis on X-ray and he had in fact been free from infection since the transmetatarsal amputation.

Treatment of the ulcer at the multidisciplinary team (MDT) foot clinic consisted of bespoke and temporary footwear with and without bespoke inlays and removable slipper casts. The patient had been reluctant to try a below-knee non-removable cast due to his own concerns regarding infection risks. After two years with no real progression of the ulcer, he agreed to try a non-removable cast. The ulcer healed within two weeks but broke down again as soon as the cast was made removable. The ulcer did promptly heal again with further application of non-removable casts. The patient continued with these for six weeks post-healing to allow the skin to consolidate fully. Despite this, deterioration was rapid once he came out of the non-removable cast. The wound was superficial and granulating, showing no clinical signs of infection, but it was clear that offloading was the key issue with regards to keeping the wound healed.

Following consideration of all other options, referral was made to the Department of Podiatric Surgery for a surgical opinion.

SURGICAL TREATMENT

The patient attended for surgery as a day case under local anaesthesia at a community-based podiatric surgery facility. The decision was made to excise the ulcer and attempt primary closure by means of a modified single-lobed rotation skin flap, on the basis that the site had been free from infection for several years.

However, it was also understood that the prolific remodelling of the 3rd metatarsal stump was contributing and the decision was made to debulk the bone mass through the ulcer excision site. Had the ulcer been considered dirty or infected, a separate dorsal approach would have been made to avoid seeding infection. The presumed benefit of using a single incisional approach was to minimise morbidity.

Post-operation the forefoot was offloaded and activity was restricted for the first three weeks (Figure 3). Following suture removal there was some dehiscence of the wound but no infection and the incision ultimately healed in nine weeks. The patient continued to attend the MDT for check-ups for a few weeks but was discharged from their care 20 weeks following surgery (Figure 4).
LEARNING OUTCOMES

Diabetic foot ulceration is a challenging aspect of our practice and is frequently associated with prolonged morbidity and major amputation. In 2010-2011 it was costing the National Health Service roughly one billion pounds a year to manage diabetic foot complications.1 There is wide agreement that a MDT with links from the acute setting into the community is the most effective approach in the management of diabetic foot disease.5 The goal of any treatment is to reduce the risk of amputation and re-ulceration, and allow patients to maintain or restore their health-related quality of life.

There is agreement that surgical intervention should be considered when other modalities have not achieved an acceptable outcome. Prior to planning any surgery one must exclude and address co-morbidities such as infection, poor glycaemic control and poor vascular status due to the potential negative impact they may have on wound healing and to avoid secondary complications.3 Zgonis2 states that surgical intervention may be needed if there is less than a 50% reduction in wound size after four weeks of routine treatment. There are many approaches to the surgical management of diabetic foot ulceration; the shared aim irrespective of approach is always to obtain an efficient wound closure or healing with minimal morbidity,5 but also to achieve stability, durability and improved function by the means of various plastic surgical techniques.4 A key element to consider in attempting wound healing is the presence of bony prominences which frequently complicate the management of diabetic foot ulceration.5

There is some debate surrounding which skin and soft-tissue procedures are best suited for the surgical treatment of plantar ulceration. Should we excise the ulcer and leave it to heal by secondary intention or should it be primarily closed utilising plastic surgical techniques? Fischer et al6 report that the decision regarding closure is fully dependent on three key elements; firstly the extent of non-viable tissue, secondly the amount of drainage present and lastly the presence of any infection. It is agreed that severe infection needs to be treated successfully before any attempt at surgical reconstruction.4,6 Fischer et al3 recommend primary treatment of infections with antimicrobial agents prior to any surgical intervention, but in the case of limb-threatening infection it may become necessary to address the ulcer surgically in combination with antibiotic therapy.6 Cuttica & Philbin7 state that urgent surgical intervention is required in conjunction with anti-microbial treatment and routine wound care in the presence of drainage, infected non-granulating ulcer, exposed non-viable soft tissue and osteomyelitis.

Plastic surgical procedures for the management of ulceration include; single-lobed rotation skin flaps, semi-elliptical excision and excision with secondary healing. All of these are recommended, and are routinely used for the treatment of plantar foot ulcerations.7

OPTIONS FOR WOUND CLOSURE

Delayed Primary closure

Delayed primary closure has been recommended in the presence of infection.5 With this approach the wound is left open after surgery with an aim to close once there are no clinical signs of infection. Often this approach will require repeated surgical debridement and antibiotic treatment before final wound closure.

Primary closure

Typically, primary closure would be reserved for non-infected wounds but Connolly et al8 found a 90% success rate with primary closure of infected diabetic foot ulcers when patients were also co-administered gentamicin, which was infused directly in to the wound after closure through a catheter left in situ for 48 hours. Jolly et al9 recommend ulcer excisions to be closed primarily; this, according to the authors, facilitates faster healing in contrast to healing by secondary intention. A study by Garcia-Morales et al10 found that primary surgical closure of diabetic foot ulcers with osteomyelitis was not associated with a greater complication rate in comparison to closure by secondary intention. The primary closure group was found to heal faster (9.9 ± SD 8.4 vs. 19.1 ± SD 16.9 weeks). It also needs to be highlighted that both groups received empiric antibiotics of amoxicillin/clavulinate for four weeks and all were subjected to resection of infected bone.

Semi-elliptical incision for the excision of a plantar ulcer is a simple technique that allows for direct closure. However, it is recommended only when ulcers measure less than 2.5 cm.7 The technique should follow the 3:1 or 4:1 ratio, to ensure satisfactory closure. The danger of attempting to close bigger ulcers is that this approach can cause extensive skin tension, which may compromise healing.10 For this reason, other techniques have been recommended and should be considered if appropriate, such as rotation skin flap or
IT IS UNDERSTANDABLE THAT THE LITERATURE IS CONTROVERSIAL WITH REGARDS TO CLOSURE OF PLANTAR ULCERATIONS

advancement flaps. 

The rotation skin flap is reported to be a viable option in weight bearing areas when simple excision is contraindicated. The concept of rotating nearby skin allows surgeons to avoid secondary defects, to excise the whole lesion and also to ensure a good blood supply.11

The Robin Hood principle, quoted by Zgonis (2009) and described by Sutton & Quatella,12 makes sense in the treatment of plantar ulcers in weight bearing areas. 

The concept of healing the skin and rotating or transposing it to the adjacent defect is one of the advantages of rotation skin flaps. Skin flaps also preserve the sweat glands that help to lubricate the skin; this facilitates healing and reduce the risk of recurrence.5 Simultaneously it allows surgeons adequate and easy exposure to underlying bone to be resected if necessary. Nevertheless, there is a lack of data when it comes to the single-lobe rotation skin flap and its place in treating diabetic ulcers.

A recent case study by Boffelli & Hyllengren13 found that a single-lobe rotation skin flap allows full excision of the ulceration and also allows exposure for any osseous resection that may be needed and subsequent coverage with healthy soft tissue. In their study they found the patient to be healed at the six-week follow up with no recurrence reported after six years. The patient had a non-healing ulcer at the medial plantar aspect of the hallux with the presence of underlying osteomyelitis.

Healing by secondary intention

Jolly et al14 recommend leaving the surgical wound to heal by secondary intention, once the ulcer has been excised. This is due to the possible presence of infection and reduced vascular supply. In the case of infection, leaving wounds open would assist in drainage of discharge and exudate aiding healing.6

Zgonis et al15 however report that ulcers healed by secondary intention are more prone to secondary lesions and reduced durability when healed, therefore increasing the risk of further breakdown and re-ulceration. This is supported by Semer & Adler-Lavan16 who report that ulcers healed by secondary intention have a less stable scar. They also produce a wider and deeper scar in comparison to wounds that have been primarily closed.10

One could debate whether the resection of underlying osteomyelits alone could potentially allow healing without the use of a flap. This is emphasised by Jolly et al7 who do not support the idea of flap coverage; as most plantar ulcerations have an underlying osseous component, and by resecting the underlying cause one would achieve healing after two-three weeks without closure.

What they do not mention is that these plantar ulcerations typically occur in weight-bearing areas, and the healed ulcer will therefore be exposed to high pressure. Since secondary healing results in reduced tensile strength of the skin, it could increase the risk re-ulceration due to the weak and unstable scar that follows.9 In comparison, a skin-flap technique will allow coverage of the ulcer and provide a more stable structure.

CONCLUSION

It is understandable that the literature is controversial with regards to closure of plantar ulcerations. The premise of closing the ulcer is to achieve quicker healing and allow adequate tensile strength of the skin when healed, therefore reducing the risk of re-ulceration.

In the current case study, the patient underwent both resection of the underlying bony prominence and a rotation skin flap to cover the excised defect. Although the patient experienced some early dehiscence, the wound ultimately healed allowed a safe discharge from the hospital-based MDT. It is understood that closing a plantar ulceration may be successful in the right candidate following a careful examination and discussion of the options and risks.